A REVIEW OF THE SMALL CARPENTER BEES, *CERATINA,* FROM KOREA, WITH THE DESCRIPTION OF A NEW SPECIES (HYMENOPTERA: APIDAE)[1]

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ABSTRACT: Four species of the small carpenter bees, the genus *Ceratina* Latreille, are recognized in Korea, including a new species described here. The new species, *Ceratina* (*Ceratinidia*) *jejuensis* sp. n., was collected exclusively from Jeju Island, the southernmost adjunct from the Korean Peninsula. It belongs to the *C.* (*Ceratinidia*) *flavipes*-group, and is easily distinguished from the other species of this group, *C.* (*Ceratinidia*) *flavipes, C.* (*Ceratinidia*) *maai,* and *C.* (*Ceratinidia*) *takasagona,* by the characteristic color patterns of head, clypeus, thorax and metasoma, and the shape of sternal teeth and apical lobes on sixth metasomal segment. An identification key to the species of the *C.* (*Ceratinidia*) *flavipes*-group is presented with color illustrations of male and female adults of *C.* (*Ceratinidia*) *jejuensis* sp. n.

KEY WORDS: *Ceratina,* small carpenter bee, *Ceratina* (*Ceratinidia*) *jejuensis,* Korea

The small carpenter bees, *Ceratina* Latrielle, constitute a generally solitary group, but occasionally are semisocial or delayed eusocial (Maeta et al., 1993), belonging to the tribe Ceratinini in the subfamily Xylocopinae. *Ceratina* is one of the common pollinators of various wild plants in Far Eastern Asia, and adult females of many species use holes in the narrow stems or twigs of dead plants (*Miscanthus, Artemisia, Phragmatis* spp. etc.) as nests for brood rearing. Adults are generally shiny black, superficially nearly hairless with many yellow markings on the face, and frequently also on the thorax, legs and metasomal tergites. They are medium-sized to small, ranging from 3.0 mm to 12.5 mm in body length. The genus *Ceratina* consists of 19 subgenera, none of which occurs naturally in both the Eastern and Western hemispheres. There are 13 subgenera in the Eastern Hemisphere, of which only three species [subgenera *Ceratina sensu stricto* (*C. satoi* Yasumatsu, 1936) and *Ceratinidia* (*C. flavipes* Smith, 1879 and *C. japonica* Cockerell, 1911)] have been reported in Korea (Anonymous, 1994).

The subgenus *Ceratinidia* is an oriental subgenus found from Sri Lanka and India throughout southeastern Asia, north to China, Korea and the maritime province of Far Eastern Russia, including Japanese Islands, Taiwan, the Philippines, and Indonesia east to the western end of New Guinea (Michener, 2000). There are about twenty-six species known in these regions (Vecht, 1952; Yasumatsu and Hirashima, 1969; Shiokawa and Hirashima, 1982). The *flavipes*-group of the subgenus *Ceratinidia* Latreille, which was proposed by Yasumatsu and Hirashima (1969), is composed of three species from the Far Eastern Asia, including Korea, China, and Taiwan. Among them, *C. flavipes* is rather widely

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distributed in Korea, Northern China, and Japan. The other two species, *C. takasagona* Shiokawa and Hirashima, 1982 and *C. maai* Shiokawa and Hirashima, 1982, are reported to have limited distributions in Taiwan (Meishan) and Southern China (Chaowu, Tachuland, Fukien and Chungan, Tsiliohiao), respectively.

The subgenus *Ceratina* Latreille *sensu stricto* is rather widely distributed in the Palaearctic regions including Europe, Central Asia to Eastern Asia (Japan, Taiwan, and Thailand), and Africa. It consists of mostly black nonmetallic species with pale coloration limited to the head, pronotal lobes, and legs. There are about 20 known species worldwide, mostly small, and ranging from 5 mm to 9 mm in length.

From recent collections of bees from South Korea, we recognized four species of the genus *Ceratina* from Korea, including a new species of the *flavipes*-group from the southern subtropical island, Jeju-do.

METHODS

For this study, specimens of *Ceratina* were collected directly on various wild flowers using insect nets. Many specimens were also collected using yellow pan traps (YPT), 18 cm diameter plastic dishes, filled with about one-fourth liter of clean water and two drops of dishwasher detergent.

Most specimens studied as well as the holotype designated used in this study are deposited in the College of Agriculture and Life Sciences, Seoul National University (CALS SNU, Korea). Some paratypes and other specimens are deposited in the National Institute of Agricultural Sciences and Technology (NIAST), Suwon, Korea.

For the collection data, abbreviations for the provincial names of South Korea are used, as follows: GG – Gyeonggido, GW – Gwangwondo, CB – Chungcheongbukdo, CN – Chungcheongnamdo, GB – Gyeongsangbukdo, GN – Gyeongsangnamdo, JB – Jeollabukdo, JN – Jeollanamdo, JJ – Jejudo, UR – Ulreungdo. Plant names of host flowers are according to The International Plant Names Index (2004).

Genus *Ceratina* Latreille

Subgenus *Ceratina* Latreille s. str., 1802

Clavicera Latreille, 1802a, Histoire Naturelle des Fourmis xvi: 432. Type species: *Hylaeus albilabris* Fabricius, 1793 = *Apis cucurbitina* Rossi, 1792

Ceratina Latreille, 1802b, Histoire Naturelle Générale et Particulière des Crustacés et des Insectes 3: 380. Type species: *Hylaeus albilabris* Fabricius, 1793 = *Apis cucurbitina* Rossi, 1972.

Ceratina (*Ceratina*) *satoi* Yasumatsu, 1936

Ceratina satoi Yasumatsu, 1936, Annot. Zool. Japon., 15(4): 550-553.

Ceratina (*Ceratina*) *satoi:* Yasumatsu and Hirashima, 1969, Kontyu 37: 66.

Specimens examined. 2♂, Cheonan (Mt. Heugseong), CN, 11.iv.1998, leg. June Yeol Choi; 1♂, Seonheul, Jocheon, Bujeju, JJ, 17.vii.1997, leg. Seunghwan Lee.

Distribution. Korea (Southern Part of the Korean Peninsula, Jeju Island) and Japan (Hokkaido, Honshu, Kyushu, Shikoku, Hachiho-jima, Ryukyus), and China (Southeastern Part).

Remarks. This species was described in the Nearctic subgenus *Zadontomerus* by Yasumatsu (1936), but was placed to *Ceratina* s. str. by Yasumatsu and Hirashima (1969). It is not common in the Korean Peninsula. Only two males were collected in the Korean peninsula and one male was collected in Jeju Island.

Subgenus *Ceratinidia* Cockerell and Porter, 1899

Ceratina (*Ceratinidia*) Cockerell and Porter, 1899, Annals and Magazine of Natural History (7)4: 403-421. Type species: *Ceratina hieroglyphica* Smith, 1854, by original designation.

Ceratina (*Ceratinidia*) *flavipes* Smith, 1879

Ceratina flavipes Smith, 1879, Description of new species of Hymenoptera in the collection of the British Museum. p 73.

Ceratina (Ceratinidia) flavipes: Shiokawa, 1963, Kontyu, 31: 276.

Specimens examined. 1♀, Chuncheon, GW, 13.vi.1996, leg. Hyun Jung Choe; 1♂1♀, Mt. Taehwa, Gwangju, GG, 22.vii.1998, leg. Seunghwan Lee; 1♀, ditto, 19.viii.1998, leg. Seunghwan Lee on *Patrinia scabiosaefolia* Link (Valerianaceae); 1♂2♀, Suwon, GG, 20-21.vi.1980, leg. Jong Cheol Paik; 1♀, ditto, 24.vi.1994, leg. June Yeol Choi; 1♀, Suwon, GG, 11.ix.1995, leg. Seunghwan Lee, on *Lycium chinense* Mill (Solanaceae); 1♀, Mt. Gwanggyo, Suwon, GG, 28.viii.1995, leg. Seunghwan Lee; 2♀, Suwon, GG, 27.vii.1995, leg. Hwang Yong Kim, on *Rudbeckia laciniata* L. (Asteraceae); 1♀, ditto, 31.iii.1998, leg. Seunghwan Lee; 1♀, Mt. Yeogi, Suwon, GG, 15.vii.1993; 1♂, Suwon, GG, 16.iv.1994, leg. June Yeol Choi; 1♂, ditto, 22.v.1995, leg. June Yeol Choi; 2♀, ditto, 16.ix.1995, leg. Seunghwan Lee, on *Lespedeza bicolor* Turcz. (Leguminosae); 1♂, Mt. Ungil, Yangpyeong, GG, 19.x.1995, leg. Hwang Yong Kim; 1♀, Gongsan-seong, Gongju, CN, 29.v.1994, leg. June Yeol Choi; 4♂, Baenaegol, Eonyang, Ulsan, GN, 27.v.1998, leg. Seung Hwan Lee, on *Artemisia princeps* Pamp. (Compositae); 1♀, Dogo-ri, Ssangchimyeon, Sunchang, JB, 12.viii.1998, leg. Seunghwan Lee, on *Lespedeza bicolor;* 1♀, Mt. Baegun, Chusan, Gwangyang, JN, 30.vii.1998, leg. June Yeol Choi.

Distribution. Korea, Northern China, Japan.

Remarks. This species is common in the main Korean peninsula, Japan, and Northern China but has not been collected in Jeju Island.

Ceratina (*Ceratinidia*) *jejuensis* S. Lee sp. n.

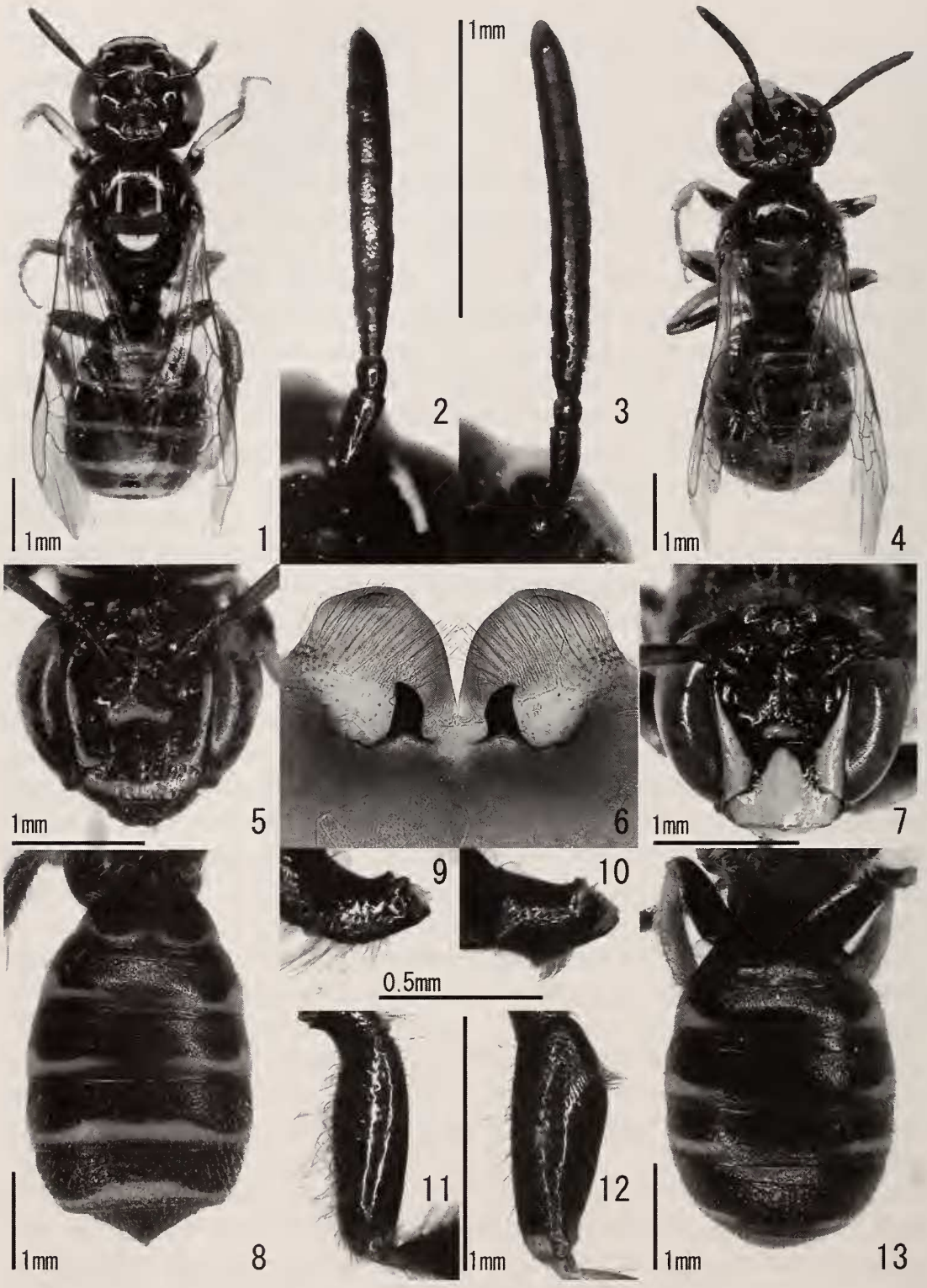
Male. *Color.* Body shiny black, except yellow markings as below (Figs. 1-13). **Head** black shiny with triangular yellow mark on clypeus; frons with well-developed broad yellow mark laterally on paraocular area, attaining antennal socket; yellow mark below well-developed frontal line near clypeus; labrum pale yellow with pair of dark markings laterally and median additional one to clypeal articulation; mandible reddish brown on distal 1/3, yellow in middle, and shiny black basally (Fig. 7). Antennae dark reddish brown with pale yellow small markings at base and distal end of scape (Fig. 3). **Thorax** shiny black except small yellow spot on pronotal lobe; legs with yellow marks on tibiae and tarsi including pretarsi, frequently extending onto ventral parts of front femur and anterior end of femur distally (Fig. 4). **Metasoma** black shiny or blackish brown with narrow yellow bands on lateral parts of posterior margins of terga 1-4 (Fig. 13).

Morphology. Body 5.0 – 6.2 mm long. **Head:** Clypeus rather smooth with a weakly developed median longitudinal carina, with many small punctures laterally; frons smooth with 15-20 punctures along compound eye anterior to antennal socket; frontal line sharply carinate between antennae; antennal grooves smooth with 10-15 punctures along frontal line; vertex between ocelli and compound eye smooth, 20-30 punctures on frons anterior to ocelli, densely covered with long hairs and strong punctures on vertex posterior to ocelli (Fig. 7). Preoccipital carina well distinguished dorsally indistinct laterally. Antennal scape and pedicel weakly punctuated with rather long hairs, longest ones as long as median width of scape; flagellum armed with dense warts and short hairs anteriorly; last segment of flagellum 1.2 times as long as penultimate segment (Fig. 3). *Thorax:* mesoscutum smooth medially with rarely 2-3 irregular rows of punctures to parapsidal line, densely punctuated on anterior 1/3, posterior 1/4, and marginally; scutellum and metanotum densely punctured; meso- and metapleuron densely punctuated with a small smooth area below wing attachment. Hind coxa enlarged triangularly, densely punctuated with smooth lateral area; antennal cleaner well-developed by front tarsus and spur on front tibiae; outer spine well-developed on distal end of fore- and hind-tibiae; longest tibial spur more than 1/2 length of first hind tarsal segment; posterior projection of hind trochanter well-developed with a tuft of long, golden, decumbent ventral hairs on hind trochanter and hind femur (Figs. 10, 12); tarsi and tibiae covered with long hairs. Propodeum densely wrinkled basally and punctuate distally, mediolongitudinal ridge weak, but conspicuous. **Metasoma:** metasomal terga with dense punctures; terga 4-6 with combination of large and small punctures; median apex of tergum 7 distinctly produced, lateroapical portions with an area of smooth surface. Sixth metasomal sternum (Fig. 6) with a pair of well-developed apical lobes, with many pale yellow hairs except on apical margin and bases of median teeth; subapical depression armed with a pair of strong teeth, arising at basal ridge of depression; teeth bent outward at apices, as long as distance between two teeth.

Female. *Color.* Body shiny black with conspicuous yellow markings as follows. Head shiny black with well-developed transverse yellow mark on anterior margin of clypeus (Fig. 5); longitudinal yellow stripe of paraocular area along compound eye bent inward anteriorly, frequently interrupted in middle; a median horizontal yellow stripe on upper border of clypeus below antennal sockets; a pair of eyebrow shape spots between antennae and ocelli. Thorax shiny black with yellow spots on lateral margin of pronotum and pronotal lobe, two pairs of long mesial and short marginal lines on scutum, one triangular large spot on scutellum (Fig. 1). Legs reddish brown to dark brown except tibiae and tarsi paler than femur, with a yellow spot at bases of tibiae. Metasomal terga 1-5 with transverse posterior yellow bands; band interrupted on tergum 1 in middle, each side with bowl shape depression; terga II-III with bands narrow and interrupted in middle, broad laterally; terga IV-V with complete bands, broader in middle and each margin (Fig. 8). Genitalia similar to *C. flavipes* and *C. maai:* gonocoxite strongly constricted before gonostylus; distal apex of gonostylus obtuse with many long hairs (ca. 20); penis valve very long and tapering, sickle-shaped, consisting basal stem and distal blade, distal blade more than 3 times as long as basal stem; spatha broadly rounded apically and abruptly narrowed and stemmed posteriorly, forming mushroom shape.

Morphology. Body 5.7 – 8.5 mm in length. **Head:** Clypeus conspicuously punctured, ridged medio-longitudinally, frons with 10-15 punctures on paraocular area between clypeus and compound eyes, anterior to antennal attachment, along median ridge between antennae. Scutum smooth medially with 1-2 irregular rows of punctures along medial line, finely and strongly punctured on anterior 2/5, posterior 1/5, and marginally. Scutellum sparsely punctured in middle. Hind trochanter without posterior projection; hind trochanter and femur without the tuft of long golden decumbent ventral hairs (Figs. 9, 11)

Type Materials. Holotype: male, Seonheul, Jocheon, Bugjeju, JJ, South Korea, 17.vii.1997, leg. Seunghwan Lee (YPT). Paratypes: 34♀28♂, from the same collection of holotype; 8♀2♂, same location of holotype, 17.iv.1998, Seunghwan Lee; 3♀, ditto, 17.iv.1998, leg. Seunghwan Lee (YPT); 3♀, ditto, 17.vii.1998, leg. Seunghwan Lee; 1♂, Citrus Experimental Station, Namwon, Namjeju, JJ, 23.xi.1996, leg. June Yeol Choi, by Malaise Trap; 1♀, Namwon, Namjeju, JJ, 25.viii.1994, leg. Deok Seo Ku; 5♂2♀, Jedong, Namwon, Namjeju, JJ, 17.iv.1996, Leg. Seunghwan Lee; 2♀, Jeju Country Club, Jeju, JJ, 10.vi.1998 (YPT); 1♀, Eorimog, Bugjeju, JJ, 10.viii.1995, leg. Seunghwan Lee; 1♀, Goraengjipojang, Bugjeju, JJ, 15.iv.1998, leg. Seunghwan Lee; 3♀, Gwaneumsa, Jeju, JJ, 26.v.1985; 3♂16♀, ditto, 17.vii.1997, leg. Seunghwan Lee (YPT); 3♀8♂, ditto, 17.iv.1998, leg. Seunghwan Lee (YPT); 2♀, 1100m Rest Area, Mt. Halla-san, Seogwipo, JJ, 11.vi.1998, leg. Seunghwan Lee; 1♀, Natural Forest Resort, Mt. Halla-san, Seogwipo, JJ, 17.iv.1998, Seunghwan Lee.



Figures 1-13. *Ceratina* (*Ceratinidia*) *jejuensis* S. Lee sp. n.: 1, Female adult; 2, Antenna of female; 3. Male antenna; 4, Male adult; 5, Frontal view of female head; 6, Sixth abdominal sternum of male; 7, Frontal view of male head; 8, Dorsal view of female abdomen; 9, Hind trochanter of female; 10, Hind trochanter of male; 11, Hind femur of female; 12, Hind femur of male; 13, Dorsal view of male abdomen.

Distribution. Korea (Only in Jeju Island)

Etymology. The species name *'jejuensis'* is derived from the name of type location 'Jeju-do' where all type series were collected.

Diagnosis. Color pattern and genitalia of male *C.* (*Ceratinidia*) jejuensis sp. n. similar to that of *C.* (*Ceratinidia*) *flavipes* and *C.* (*Ceratinidia*) *maai,* from which this new species can be distinguished by the frons which has broad black gaps between the yellow clypeus and paraocular areas, thus forming the triangular yellow pigmentation on clypeus (Frons entirely covered by yellow pigmentation in *C.* (*Ceratinidia*) *flavipes* and with narrow black gaps on the epistomal suture in *C.* (*Ceratinidia) maai,* making an upside-down hat shape). In addition, the new species is distinguished from *C.* (*Ceratinidia*) *flavipes* by the angulated produced apical lobes on 6th sternum (apical lobes smooth without angulated points in *C.* (*Ceratinidia*) *flavipes* and is also distinguished from *C.* (*Ceratinidia*) *maai* by the apical lobes with hairs confined to the middle (hairs distributed on the whole apical lobes in the latter species). The color pattern of female adults of the new species is similar to the Taiwanese species, *C.* (*Ceratinidia*) *takasagona,* from which it can be differentiated by the shape of yellow pigmentation on the first metasomal tergum and the clypeus.

Ceratina (Ceratinidia) japonica Cockerell, 1911

Ceratina hieroglyphica var. *japonica* Cockerell, 1911. Proceedings of the United States National Museum, 39: 635.

Ceratina (*Ceratinidia*) *japonica:* Shiokawa, 1963, Kontyu, 31: 278.

Specimens examined. Numerous males and females were collected throughout South Korea, excluding Jeju Island, using yellow pan traps (YPT), sweep nets, and by hand directly on flowers. They are found continuously from April to October, and are common in spring, April-May, and early autumn, August-September.

Host flowers observed. *Carduus crispus* L. (Asteraceae), *Chaenomeles lagenaria* Koiduzumi (Rosaceae), *Chrysanthemum indicum* L. (Compositae), *Erigeron Canadensis* L. (Asteraceae), *Lespedeza bicolor* Turcz. (Leguminosae), *Malus pumila* Mill. (Rosaceae), *Patrinia scabiosaefolia* Link (Valerianaceae), *Pueraria thunbergiana* Benth (Leguminosae), *Rhododendron mucronulatum* Turcz. (Ericaceae), *Rhododendron schlippenbachii* Maxim (Ericaceae), *Rosa multiflora* Benth. (Rosaceae), *Saussurea pulchella* Fisch. ex Colla. (Compositae), *Vicia amurensis* Oettingen (Leguminosae), *Youngia sonchifolia* Maxim. (Compositae).

Distribution. Korea (mainland of the Korean Peninsula, excluding Jeju Island), Japan, China.

Remarks. This is the most common species of the genus *Ceratina* in Far Eastern Asia. However, it has not been recorded in Jeju Island.

Key to the species of the *Ceratina* (*Ceratinidia*) *flavipes*-group

Males

1. Clypeus, paraocular area, and supraocular area wholly yellow without dark gaps between clypeus and paraocular area. All transverse yellow band of metasomal terga broadly interrupted medially. (Widely distributed in Far Eastern countries: Korean Peninsula, Japan, China) ....*Ceratina* (*Ceratinidia*) *flavipes*

- Frontal pigmentation on clypeus, paraocular area, and supraocular area separated by black areas along the sutures. Transversal yellow bands, at least of terga 4-5, not broken or with narrow gaps only in middle 2

2. Preoccipital carina low but distinct. Seventh tergum with apical margin only slightly produced apically in middle, latero-apical portions coarsely sculptured as in rest of same tergum. Hind femur rather thick with anterior face distinctly convex; subapical tuft of decumbent golden hairs not arranged in a compact fringe. Sixth sternum with a pair of small denticles very close together. Body length less than 5.5 mm. (Taiwan: Meisan, Nantow). ....*Ceratina* (*Ceratinidia*) *takasagona*

- Preoccipital carina weak or absent. Seventh tergum with apical margin distinctly produced apically in middle, latero-apical portions broadly smooth and shining. Hind femur not thick; subbasal tuft of golden decumbent hairs long and arranged in a compact fringe. Sixth sternum with a pair of robust and broadly separated denticles. Larger species 3

3. Yellow pigmentation covering on almost whole clypeus except narrow gaps on epistomal suture, forming hat-shaped yellow marking on clypeus. Transverse yellow bands on anterior three metasomal terga narrowly interrupted and distal two band with narrow gaps. Hairs on apical lobes of sixth metasomal sternum distributed over entire lobes. (China: Fukien) ....*Ceratina* (*Ceratinidia*) *maai*

- Yellow marking on clypeus triangular, broadly interrupted along epistomal suture (Fig. 7). Transverse yellow bands on terga broadly interrupted (Fig. 13). Hairs on apical lobes of sixth abdominal sternum confined in the middle of lobes, base and apices of lobes bare (Fig. 6). (Korea: Jeju Island)..... .....*Ceratina* (*Ceratinidia*) *jejuensis* S. Lee sp. n.

Females

1. Thorax with two pairs (medial and lateral) of well developed longitudinal yellow streaks on scutum; transverse yellow bands on metasoma complete, not interrupted medially 2

- Thorax with one pair of longitudinal yellow streaks on scutum; transversal yellow bands interrupted at least on first and second terga 3

2. Preoccipital carina low, but distinct; clypeus not coarsely sculptured, rather smooth, shiny, with a median longitudinal ridge; yellow mark on clypeus large, inverted T-shaped. Transversal yellow marking on first metasomal tergum broad with two small black spots laterally. Body length 5 – 7 mm. (Taiwan: Meisan, Nantow) .....*Ceratina* (*Ceratinidia*) *takasagona*

- Preoccipital carina absent; clypeus sculptured without or with very indistinct indication of longitudinal ridge; yellow mark transverse, without longitudinal bar. Transversal yellow marking on first metasomal dorsum not as above, almost W-shaped with a small longitudinal bar in middle. Relatively large species, 5.7-8.4 mm in body length. (Korea: Jeju Island) ....*Ceratina* (*Ceratinidia*) *jejuensis* S. Lee sp. n.

3. Preoccipital carina weak but often well recognizable; basal area of propodeum usually without a median ridge; metasomal yellow bands, especially those on three basal terga, not well developed; clypeus without median ridge. (Widely distributed in Far Eastern countries: Korean Peninsula, Japan, China) .....*C.* (*Ceratinidia*) *flavipes*

- Preoccipital carina absent; basal area of propodeum with a median longitudinal ridge (although weak); metasomal yellow bands well developed; clypeus with an indication of median ridge. (China: Fukien)....*C.* (*Ceratinidia*) *maai*

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